Name: _____ Date: _____

Linear Motion and Acceleration

Objective:
To investigate the relationship between distance and time for a ball rolling down an incline.

Equipment:

ramp (approximately 2 m)	steel ball bearing
wood block	stopwatch
tape	meterstick
protractor	

Procedure:
Part A:
1. Set up a ramp with the angle of the incline at about 10° to the horizontal.
2. Divide the ramp's length into six equal parts and mark the six positions on the board with pieces of tape. These positions will be your release points. Place a stopping block at the bottom of the ramp to allow you to hear when the ball reaches the bottom. Record these distances in Table A.
3. Use either a stopwatch or a computer to measure the time it takes the ball to roll down the ramp from each of the six points. Use a ruler or pencil to hold the ball at its starting position, then pull it away quickly parallel to incline to release the ball uniformly. Do several practice runs with the help of your partners to minimize error.

Part B:
4. Repeat steps 2-4 with the incline set at an angle five degrees steeper. Record the data in Table B.

Part C:
5. Remove the tape marks and place them at 10 cm, 40 cm, 90 cm, and 160 cm from the stopping block. Set the incline if the ramp to ten degrees.
6. Measure the time it takes for the ball to roll down the ramp from each of the four release positions. Make at least three timings from each of the four positions and record the data in Table C.
7. In his famous experiments with inclined planes, Galileo averaged the time interval in the first row and referred to it as a "natural unit" of time. The other values in the column are found by determining the ratio of each successive difference to t_1. You will then round these numbers off to the nearest whole integer.
8. Complete Table D with the results from Part C.

Data:

Table A

Distance (cm)	Time (s)			
	Trial 1	Trial 2	Trial 3	Average

Table B

Distance (cm)	Time (s)			
	Trial 1	Trial 2	Trial 3	Average

Table C

Distance (cm)	Rolling Time (s)				Difference between Intervals (s)	Time in "Natural Units"
	Trial 1	Trial 2	Trial 3	Average		
10				t_1=		1
40				t_2=	$t_2 - t_1$ =	
90				t_3=	$t_3 - t_1$=	
160				t_4=	$t_4 - t_1$=	

Table D

Distance Traveled (cm)	Time in "Natural Units"	Square of Time in "Natural Units"	Ratio of Distance to Square of Time
10			
40			
90			
160			

Name: _____ Date: _____

Analysis/Conclusion:

Parts A and B:

1. Does the ball accelerate down the ramp? Cite evidence from the lab to defend your answer.

2. What happens to the acceleration if the angle of the ramp is increased?

Part C:

3. What happens to the speed of the ball as it rolls down the ramp? Does it increase, decrease, or remain constant? What evidence can you cite to support your answer?

Part D:

4. What is the significance of the ratio found in part D? How does it relate to the ball rolling down the ramp?